

PART IN-540 FIELD SURVEYS

IN540.01 Format

Technical Release 62 and the Engineering Field Handbook shall be used as guides for format and content of engineering field notes.

IN540.02 Precision and Accuracy

- (a) The required precision and accuracy of each survey will vary with its purpose; however, the minimum requirements shall be with the framework outlined in Chapter 1 of the Engineering Field Handbook and as outlined below.
- (b) Measurement of Horizontal Distances
 - (1) Horizontal lengths shall be measured in a horizontal plane. Direct measurements are made by wheels, tapes (cloth or metallic) and pacing. Indirect measurements are made by stadia, total stations, and GPS survey instruments, and other electronic distance measuring instruments.
 - (2) Pacing shall not be used to measure horizontal distance for design, construction layout, or construction check surveys.

IN540.07 Installation of Survey Markers

- (a) General
 - (1) This part states policy regarding placement of survey markers on completed major or important structures in which the NRCS has engineering input and/or interest.
 - (2) Permanent NRCS survey markers will be set on centerlines and/or baselines to facilitate relocation of the line for future study and in the top of concrete structures. Permission to set the markers shall be obtained from the owner of the structure.
- (b) Placement
 - (1) A supply of standard bronze survey markers shall be obtained and retained under the control of the State Conservation Engineer. Requests by the responsible engineer for the markers, in the quantity desired, shall be directed to the State Conservation Engineer, indicating the particular project on which it is to be used. The State Conservation Engineer will furnish the necessary markers to the responsible engineer, as required.
 - (2) A minimum of two (2) monuments shall be placed on the center line of fill, other normal baseline references across the structure, or downstream face of headwall. The cast-in-place concrete may be obtained by the use of prepackaged concrete mixes.
 - (3) Survey markers may also be set in the freshly poured concrete headwalls of drop spillways, chutes, inlets, riser, impact basins, or other concrete parts of important structures. Markers shall be set where they can easily be seen and used.
- (c) Identification

- (1) Survey markers shall be identified only with the Department and NRCS names and suitable project and marker identification.
 - (2) After a marker is installed, a permanent identification shall be inscribed on the face of the marker by the use of a punch, etching tool, or other suitable tool. The identification shall be keyed to the name of project and/or other associated name or number, a marker number, and the year installed.
 - (3) After the survey marker has been installed, the marker will be surveyed to permanently locate the marker with three-point references where required for ease of relocation and to determine the elevation of the top of the marker. This information shall be placed on as-built drawings and filed in the field office, which is assigned administrative responsibility for the area in which the structure is located. The responsible engineer may keep a copy of the information. THE ELEVATION DETERMINED SHALL NOT BE INSCRIBED ON THE MARKER.
- (d) Information
- (1) It is NRCS policy to provide any available information about the markers to interested persons. If inquiries as to the meaning an/or purpose of the markers are made, they shall be referred to the field office that has the administrative responsibility for the area in which the structure is located.
 - (2) The elevations of the markers, as determined by the NRCS, shall be furnished. However, the recipient shall also be given simultaneous information as to the degree of accuracy to which the elevation was set, the benchmark used as a starting point, and the potential change in elevation of the marker in the time interval since the NRCS determined the elevation. THE NRCS ACCEPTS NO RESPONSIBILITY FOR THE ACCURACY OF THE ELEVATION OR OTHER INFORMATION FURNISHED.

IN540.08 Vertical Control

Mean seal level datum shall be used for all elevations for vertical control, except that an assumed elevation datum may be used for jobs that do not require approval by any governmental agency or railroad. Where assumed elevations are used, they shall be so identified.

IN540.09 Accuracy in Surveying for Project Work

All vertical and horizontal control shall meet the requirements shown in Table 1-1 in the Engineering Field Handbook for ordinary surveys, except as modified below.

- (a) Horizontal Control.
- (1) Linear Measurements (Baselines, including centerline fill, centerline structure, etc.) - Horizontal chaining or Electronic Distance Measuring instruments.
 - (2) Angular Measurements - Read angles to nearest 1 minute

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(b) Vertical Control

(1) To establish elevations on new bench marks from established bench marks (at least one within each structure site or channel reach):

- (i) Method - Level and rod, electronic survey equipment
- (ii) Accuracy - maximum error of vertical closure = $0.05 \sqrt{M}$ (M is the miles of levels run)

(2) To establish elevations on Temporary Bench Marks (TBM's) within a structure site or channel reach:

- (i) Method - Level and rod, electronic survey equipment
- (ii) Accuracy - Engineering Field Handbook, Table 1-1, ordinary surveys

(3) Accuracy of reading and recording

- (i) Level circuits - 0.01 ft.
- (ii) Concrete or pipe invert elevations - 0.01 ft.
- (iii) Earth elevations - 0.1 ft.

IN540.10 Topographic Mapping

- (a) The detail shown on topographic maps shall include all features visible; such as, but not limited to, buildings, road, trails, highways, railroads, canals, bridges, reservoirs, cemeteries, utility lines, quarries, fence lines, drainage ways, creeks, rivers, ponds, wells, spring, and vegetation and critical environmental features. Lowest ground elevations shall be shown at each building to the nearest 0.1 foot; show lowest floor elevation to 0.1 foot; show basement floor elevation to 0.1 foot.
- (b) Known underground utilities; section, township, and range lines; other civil boundaries; and known property lines shall be shown and identified.
- (c) Names of apparent property owners shall be shown. Ownership of utility lines (telephone, power, gas, etc.) shall be shown.
- (d) Channel bank and thalweg elevations should be shown at each property line crossing.
- (e) Permanent control points shall be established during the survey, marked and referenced with three-way references so that they can be readily re-established. The location and description of all control points shall be accurately recorded.
- (f) Benchmarks and temporary benchmarks shall be established during survey for use during construction. The location, description and elevation of each benchmark shall be accurately recorded. Mean sea level datum shall be used for all work requiring approval outside the NRCS.
- (g) Each map will show a bar scale, North arrow, source photo and date information, or quad sheet identification, as applicable.

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- (h) Mapping shall include an area a sufficient distance outside the contemplated work area to permit review and understanding of the work site limitations.

- (i) Plotted maps should be at scales convenient for the designer to show the work involved. Generally, maps for dam and other structures sites should be at a scale of 1" = 50'; maps for detention and borrow areas at 1" = 200'; detail maps for special areas at 1" = 20'.
- (j) The vertical interval of contour lines on maps prepared for design shall be:
 - (1) In structure and emergency spillway areas - two (2) feet.
 - (2) In reservoir, borrow areas, and park developments - four (4) feet
 - (3) In flood plains for channels - one (1) foot.

Elevations of contour shown divided by the contour interval shall result in a whole number.

IN540.11 Profiles

- (a) Length
 - (1) Valley profile of main stream and all branch streams shall extend a sufficient length above and below work reach to show channel stability and effect on upstream developments.
 - (2) Centerline of embankment profiles shall extend a minimum of 5 feet vertically above top of dam elevation and/or emergency spillway side slope excavation from one abutment to the other.
 - (3) Principal spillway profiles shall extend from a minimum of 50 feet upstream of embankment toe to the intersection of the outlet channel with natural stream and/or 50 feet downstream of the approximate location of stilling basin and or sediment trap.
 - (4) Emergency spillway profiles shall extend from normal pool elevation at inlet to outlet into natural stream.
- (b) Plotting (on profile grid)
 - (1) Vertical - 1" = 2' 4' or 8'
 - (2) Horizontal - adjust scale to fit profile on one sheet; 1" = (1, 2, 3, or 8) times (10, 100 or 1000).

IN540.12 Cross-sections

- (a) Plot on 10x10 cross-section paper.
- (b) Generally, cross sections should be plotted at a vertical scale of 1" = 10' and a horizontal scale of 1" = 20'. Other scales can be used when greater detail is desired or for specific purposes.